

Wireless 9-1-1 Routing In California

Issue Paper

Issue Statement

The issue presented to the 9-1-1 Workgroup was that wireless 9-1-1 calls are not always initially routed to the appropriate Public Safety Answering Point (PSAP). The delay caused by the initial telecommunicator determining the location of the caller and transferring to the appropriate PSAP can be counted in seconds or even minutes. This delay is dependent on several factors, which include cooperation of the caller, the caller's knowledge of the geographic area, and whether or not the cellular carrier has provided Phase 2 location information (latitude/longitude).

Isolating the Issues

The delivery of Wireless 9-1-1 calls is a complex process. The current 9-1-1 system is comprised of Legacy Wireless Routing and Location Accuracy. The early stages of Next Generation 9-1-1, using the Location Based Routing method are currently being evaluated. The terms Legacy Wireless Routing, Location Accuracy and Next Generation 9-1-1 Routing/Location Based Routing, are frequently used interchangeably when in fact they are separate and distinct. This causes significant confusion when trying to isolate the issues. For the purposes of this report the following terms are elucidated below.

- Legacy Wireless Routing – wireless routing currently uses the same legacy process that was developed for landlines. This includes using an Emergency Service Number (ESN) that must be assigned to determine the receiving PSAP. This manual process, which has been in place since 2001, must be done for each cell sector residing on every cell tower in the State of California.
- Location Accuracy – all wireless 9-1-1 calls are delivered with either Phase 1 (Tower Location), or Phase 2 (Approximate caller location). Two nationwide issues that the Federal Communications Commission (FCC) is addressing are: 1) location accuracy of the Phase 2 information being delivered, and 2) the percentage of calls that are initially delivered Phase 1 instead of Phase 2. This is the CALNENA initiative.
- Next Generation 9-1-1 (NG9-1-1) Routing – wireless 9-1-1 calls can be routed based on the Phase 2 (caller location) and the jurisdictional boundaries established and agreed to

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by all parties. Until Phase 2 is reliably delivered a majority of the time, routing by caller location will not be possible and legacy based wireless routing will continue to be used.

The Workgroup is only looking at Legacy Wireless Routing. NG9-1-1 Routing and Location Accuracy are different issues that are currently being addressed in other forums.

Root Causes of the Issue

Wireless 9-1-1 calls are currently routed using the legacy routing method. This is a manual process requiring the 9-1-1 County Coordinator and CHP representative to evaluate the expected coverage of each sector based upon maps provided by the wireless service providers.³ The cellular sectors displayed upon these maps vary depending on the power of the equipment on the tower, the geographic location of the tower, can extend an average of two (2) to ten (10) miles, and with a 120 degree span, each sector can encompass many square miles, and more importantly, cross multiple jurisdictional and political boundaries. The initial routing process therefore is highly subjective. There are automated auditing tools to confirm a correct routing decision was made, but they are not being utilized at this time. There is automated network auditing technology available to assist the routing decision process, but that technology is not being fully utilized at this time and is not currently available to the PSAP's

Current legacy technology only allows a sector to route 9-1-1 calls to a single PSAP. Depending on the number of PSAPs covered within that cell sector, a decision has to be made to determine which PSAP will get the initial wireless 9-1-1 call. If the 9-1-1 caller reporting the emergency is not within the initially assigned PSAP jurisdiction, then the call must be transferred to the appropriate jurisdiction's PSAP. Transfers such as these are not misroutes. Further confusing this issue is that if the 9-1-1 caller is on or near a freeway or unincorporated county road, the call may be routed to CHP. CHP is considered a primary PSAP in California.

Historical Perspective

The California Public Utilities Commission (CPUC) Code 2892 states that wireless 9-1-1 calls will be routed to the California Highway Patrol (CHP) PSAPs, unless certain conditions are

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met which allows local government PSAPs to handle wireless calls directly.¹ These conditions are:

- (1) The “9-1-1” call originates from a location other than from a freeway, as defined in Section 23.5 of the Streets and Highways Code, under the jurisdiction of the Department of the California Highway Patrol.
- (2) The alternate routing is economically and technologically feasible.
- (3) The alternate routing will benefit public safety and reduce burdens on dispatchers for the Department of the California Highway Patrol.
- (4) The Department of the California Highway Patrol, the Office of Emergency Services, and the proposed alternate public safety answering point, in consultation with the wireless industry, providers of “9-1-1” selective routing service, and local law enforcement officials, determine that it is in the best interest of the public and will provide more effective emergency service to the public to route “9-1-1” calls that do not originate from a freeway, as defined in Section 23.5 of the Streets and Highways Code, under the jurisdiction of the Department of the California Highway Patrol to another public safety answering point.

The CPUC code was based on the premise that in the early years of the cellular industry most people making those calls were likely reporting a vehicle accident, as most wireless phones were installed in vehicles (in-vehicle cell phones are now a distant memory). In the past 14 years, cellular subscribers has almost tripled – from over 109 million to over 306 million.²

Prior to the implementation of the Routing Based on Empirical Data (RED) Project, the California 9-1-1 Emergency Communications Branch (CA 9-1-1 Branch) identified that 42.4% of the 11.6 million wireless 9-1-1 calls made in California received busy signals or failed to go through the system.⁶ 73.2% of those wireless calls were routed to the California Highway Patrol (CHP).⁸ Staffing at CHP PSAPs could not keep up with the increase in call volume. This, coupled with PSAPs who had not deployed wireless calls, caused network busies and delays in the answering and transferring of wireless 9-1-1 calls.

In 2008, the RED Project was launched. This provided the tools to analyze historical data identifying which cell sectors should be routed to the responsible jurisdiction. This historical data covered a “snap-shot in time” and the project ended in 2011. The RED Project was primarily

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designed to reduce the number of callers receiving busy signals when calling 9-1-1. After the RED Project's successful completion in 2011, the technology and automated tools developed out of the RED Project were not continued or made available to the PSAP's or CHP. It seems evident that data analysis is critical for making routing decisions. These tools and new tools as a result of the RED project are available on the CALNET contract.

The RED Project reduced the percentage of busy calls from 42.4% in 2007 to 4.5% in 2010, thus accomplishing its primary task.⁷

ECaTS

Today's Management Information System (MIS) tool is the Emergency Call Tracking System or ECaTS. In 2009, the State 9-1-1 Office through the SETNA funded the ECaTS project, which gathers historical data on more than 65,000 calls daily from 12 different manufacturer's telephone equipment. ECaTS parses the data into a standard format and produces comparative reports for individual PSAPs, separate counties, separate organizations (like CHP and CALFIRE), or statewide. The goal was to access MIS reports of the wire line and wireless 9-1-1 systems from a single web-based solution, allowing for data analysis and trend information.

Discussion

The following procedures were developed by California wireless stakeholders for the effective implementation of routing wireless calls directly to local California PSAPs that have elected to accept wireless 9-1-1 calls directly that originate within their jurisdiction.

1. Wireless 9-1-1 calls will be considered for direct routing to local PSAPs only when there is a written agreement to do so between the authorized representative of the local PSAP and authorized representative of the CHP.
2. The wireless stakeholders shall work together to identify sites that provide coverage within the jurisdictional boundaries of the local PSAP. The CHP will identify and retain responsibility for cell sites that provide coverage on freeways, county roads, and unincorporated areas within CHP jurisdiction, when appropriate. The CHP will advise the 9-1-1 Office of changes in cell site/sector call routing agreed to by all stakeholders

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3. A wireless 9-1-1 direct call routing implementation plan shall be developed for each participating agency with coordination between all wireless stakeholders. Each plan should include a process for:
 - a. Cutover to the local PSAP (slash cutover or a cell sector by cell sector, phased implementation);
 - b. Routing changes; and,
 - c. Termination of direct routing of wireless calls to the local PSAP, if it proves not to be in the best interest of the public.
4. The CHP and the participating local PSAP shall develop operating procedures to facilitate effective call handling, call transfer, or relay of information between communications centers.
5. The CHP and the 9-1-1 Office will work with all wireless stakeholders to develop procedures for release of subscriber information in emergency situations, notification of misrouted cell sites/sectors, and requests for routing changes.

Initially, CHP and the local government PSAPs do not have the benefit of historical data to ensure that wireless 9-1-1 calls are in fact being assigned to the appropriate PSAP, relying instead on best estimates of call activity and location. The potential result may be instances of 9-1-1 calls that must be transferred between neighboring PSAPs, resulting in transfers to the appropriate PSAP. Further complicating matters is that existing cell towers, may show “busy” on sectors, whereby calls are then routed to a neighboring sector, which may have a different routing plan.

Currently there is no process available to the PSAPs to analyze data from ECaTS on a local, regional, or statewide basis. There is no simplified or automated process to review data from cell sectors, allowing the ability to make sound routing change recommendations as to the appropriate PSAP available at this time. Additionally, at this time there is no process to confirm that the wireless carriers implemented the recommended routing provided by the County Coordinator and CHP.

9-1-1 calls in 2007 amounted to 11.6 million. In 2013, California received 25.7 million 9-1-1 calls. Of that, 6.7 million were received on traditional landlines and 18.9 million were received

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via cellular.⁵ That is a nearly 45% increase in 6 years, an average of 7.5% per year. Increases in call volume have and will continue, whether at the same pace or not is hard to predict.

Most emergencies are routed to the appropriate agency in a timely manner and the emergency situation mitigated successfully. However, under the current legacy based routing there will never be the ability to get a 0% transfer rate. The following considerations need to be taken into account to fully understand why.

1. Location of the caller relative to the freeway, either on the freeway or immediately adjacent to the freeway will normally cause the 9-1-1 wireless call to be automatically routed to the CHP.
2. The caller's elevation relative to the freeway cell sites. E.g., if a person dials 9-1-1 on their cell phone from a mountain trail where they've been hiking, the cellular signal can bypass the closest cell site and connect to a site that would normally be handled by the CHP. Sometimes, the signal can travel several more miles than would normally be expected due to the elevation of the caller relative to the cell site. So, topography and building elevation can impact a 9-1-1 call and subsequent routing of it.
3. Cell site availability can also be a factor; e.g. a 9-1-1 wireless caller can make a call standing immediately adjacent to a cell site, but be routed to another cell site due to that site being impaired or wholly in-use by other callers. This is also known as "handover". It is also the technology used when a caller is moving and the signal is transferred from one cell site to another for seamless communications.
4. Not all new cell towers are identified to the local county 9-1-1 coordinators by the carriers, to support whether the new tower location should route the caller to CHP or to the local municipal PSAP. Sometimes the default is the CHP in this case.
5. Not all PSAP's agree with call routing and automatically have CHP as their default routing.
6. Not all municipal PSAP's agree with call routing and therefore some have agreements between themselves as to which local PSAP is the default routing.
7. Not all phones support Phase 2 wireless (latitude/longitude information), therefore requires use of cellular tower triangulation of the callers location to perform routing. What is received at the PSAP is the address of the cell tower being used, not the location

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of the caller. If the caller is near a PSAP border, this can be an effect on routing and subsequent transfers.

8. Some callers need to be transferred to/through multiple PSAP's due to the nature of the incident; i.e. 2nd and 3rd party callers not in the immediate area of the incident or calling for a family member and do not live in the area of the incident.

Recommendations/Opportunities:

The 9-1-1 Workgroup is of the opinion that the current legacy wireless routing system is not broken. Instead it is working as designed, understanding that the current wireless location technology is not able to provide anything better. This does not mean that improved routing; work processes and quality assurance programs cannot be developed. The following are recommendations developed by the 9-1-1 Workgroup:

1. Explore available technology that could enhance the decision making process for cell sector routing and identify sectors that should be reviewed.
2. Data needs to be put into timely, user-friendly reports that can be generated by 9-1-1 personnel from their workplace, thus allowing for routing recommendations based on objective data. These reports should include, at a minimum:
 - a. Transfers to and from the PSAP
 - b. Plotting of Phase 2 calls by cell sector
 - c. Errors in routing – such as towers not listed in Database
 - d. Any routing that is inconsistent with the CHP/County Coordinator instructions
 - e. Automated alerts or warnings based upon pre-defined criteria
3. Rules/regulations/quality assurance procedures need to be put in place to ensure the cellular carriers report new towers and cell sector modifications in a timely manner and the sectors are tested to ensure correct routing.
4. There needs to be an outreach program to educate PSAPs, other public safety organizations and in some cases the citizenry about legacy system routing.
5. Develop a statewide, standardized guideline for routing changes on existing and new cell sectors.

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6. Establish a comprehensive way to track routing changes and keep historical data for reference.

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¹ California Public Utilities Code

2892.

- (a) A provider of commercial mobile radio service, as defined in Section 216.8, shall provide access for end users of that service to the local emergency telephone systems described in the Warren-911-Emergency Assistance Act (Article 6 (commencing with Section 53100) of Chapter 1 of Part 1 of Division 2 of Title 5 of the Government Code). “911” shall be the primary access number for those emergency systems. A provider of commercial mobile radio service, in accordance with all applicable Federal Communication Commission orders, shall transmit all “911” calls from technologically compatible commercial mobile radio service communication devices without requiring user validation or any similar procedure. A provider of commercial mobile radio service may not charge any airtime, access, or similar usage charge for any “911” call placed from a commercial mobile radio service telecommunications device to a local emergency telephone system.
- (b) A “911” call from a commercial mobile radio service telecommunications device may be routed to a public safety answering point other than the Department of the California Highway Patrol only if the alternate routing meets all of the following requirements:
- (1) The “911” call originates from a location other than from a freeway, as defined in Section 23.5 of the Streets and Highways Code, under the jurisdiction of the Department of the California Highway Patrol.
 - (2) The alternate routing is economically and technologically feasible.
 - (3) The alternate routing will benefit public safety and reduce burdens on dispatchers for the Department of the California Highway Patrol.
 - (4) The Department of the California Highway Patrol, the Office of Emergency Services, and the proposed alternate public safety answering point, in consultation with the wireless industry, providers of “911” selective routing service, and local law enforcement officials, determine that it is in the best interest of the public and will provide more effective emergency service to the public to route “911” calls that do not originate from a freeway, as defined in Section 23.5 of the Streets and Highways Code, under the jurisdiction of the Department of the California Highway Patrol to another public safety answering point.

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(Amended by Stats. 2013, Ch. 28, Sec. 76. Effective June 27, 2013. Operative July 1, 2013, by Sec. 93 of Ch. 28.)

2892.1.

- (a) For purposes of this section, “telecommunications service” means voice communication provided by a telephone corporation as defined in Section 234, voice communication provided by a provider of satellite telephone services, voice communication provided by a provider of mobile telephony service, as defined in Section 2890.2, and voice communication provided by a commercially available facilities-based provider of voice communication services utilizing voice over Internet Protocol or any successor protocol.
- (b) The commission, in consultation with the Office of Emergency Services, shall open an investigative or other appropriate proceeding to identify the need for telecommunications service systems not on the customer’s premises to have backup electricity to enable telecommunications networks to function and to enable the customer to contact a public safety answering point operator during an electrical outage, to determine performance criteria for backup systems, and to determine whether the best practices recommended by the Network Reliability and Interoperability Council in December 2005, for backup systems have been implemented by telecommunications service providers operating in California. If the commission determines it is in the public interest, the commission shall, consistent with subdivisions (c) and (d), develop and implement performance reliability standards.
- (c) The commission, in developing any standards pursuant to the proceeding required by subdivision (b), shall consider current best practices and technical feasibility for establishing battery backup requirements.
- (d) The commission shall not implement standards pursuant to the proceeding required by subdivision (b) unless it determines that the benefits of the standards exceed the costs.
- (e) The commission shall determine the feasibility of the use of zero greenhouse gas emission fuel cell systems to replace diesel backup power systems.
- (f) Before January 1, 2008, the commission shall prepare and submit to the Legislature a report on the results of the proceeding.

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(Amended by Stats. 2013, Ch. 28, Sec. 77. Effective June 27, 2013. Operative July 1, 2013, by Sec. 93 of Ch. 28.)

2892.3.

- (a) The commission shall require providers of mobile telephony service, as defined in Section 224.4, to report to the commission, as specified by the commission, on activities associated with customer fraud.
- (b) Each report shall include a description of the types of fraud occurring, the amount of revenues that have been uncollectible because of fraud, and the actions undertaken by the mobile telephony service provider to combat fraud.
- (c) The commission shall require mobile telephony service providers to provide their subscribers with a notice, to be reviewed by the commission, warning subscribers about problems associated with fraud, and informing them about ways to protect against fraud.

(Amended by Stats. 2006, Ch. 198, Sec. 21. Effective January 1, 2007.)

2892.5.

- (a) As used in this section “public safety agency” means a “public safety agency” as defined in Section 53102 of the Government Code.
- (b) A provider of commercial mobile radio service, as defined in Section 216.8, may enter into a contract with a public safety agency to give the transmissions of public safety agency end users of that service priority over the transmissions of other persons or entities. The contract shall comply with applicable federal law.

(Amended by Stats. 2006, Ch. 198, Sec. 22. Effective January 1, 2007.)

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California Vehicle Code

Division 2. Chapter 2. Article 3. Powers and duties

2400.(d)

The commissioner shall have full responsibility and primary jurisdiction for the administration and enforcement of the laws, and for the investigation of traffic accidents, on all toll highways and state highways constructed as freeways, including transit-related facilities located on or along the rights-of-way of those toll highways or freeways, except facilities of the San Francisco Bay Area Rapid Transit District. However, city police officers while engaged primarily in general law enforcement duties may incidentally enforce state and local traffic laws and ordinances on toll highways and state freeways within incorporated areas of the state. In any city having either a population in excess of 2,000,000 or an area of more than 300 square miles, city police officers shall have full responsibility and primary jurisdiction for the administration and enforcement of those laws and ordinances, unless the city council of the city by resolution requests administration and enforcement of those laws by the commissioner.

2400 (e) The commissioner shall have full responsibility and primary jurisdiction for the administration and enforcement of the laws, and for the investigation of traffic accidents, on all highways within a city and county with a population of less than 25,000, if, at the time the city and county government is established, the county contains no municipal corporations.

² World Bank Statistics: <http://www.statisticbrain.com/mobile-cellular-subscribers-global-us/>

³ In 1985, there were 900 cellular towers in the United States. In 2013, that number was 190,000. <http://www.statisticbrain.com/cell-phone-tower-statistics/>

⁴ Each county has its own internal procedures for making routing recommendations, which may or may not involve the affected PSAPs.

⁵ Source: Jim Thompson, Wireless E9-1-1 and Emerging Technologies Project Manager, State of California, Governor's Office of Emergency Services (CalOES), Public Safety Communications Office, CA 9-1-1 Emergency Communications Branch, Program Development Section, MS-911

⁶ Routing on Empirical Data Project Fact Sheet, March 2014

⁷ Source: State of California, Governor's Office of Emergency Services (CalOES), Public Safety

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Appendix

Communications Office, CA 9-1-1 Emergency Communications Branch

⁸ Source: Jim Thompson, Wireless E9-1-1 and Emerging Technologies Project Manager, State of California, Governor's Office of Emergency Services (CalOES), Public Safety Communications Office, CA 9-1-1 Emergency Communications Branch, Program Development Section, California Wireless E9-1-1 Routing on Empirical Data (RED) Project Presentation, July 24, 2008 <http://calnena.org/red-project/RED-Overview-NENA-07-24-08.pdf>